Space Weather Technical Forecast

Issued on Friday 28 March 2025 at 12:59 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of isolated G1/Minor storms. Chance of M-class flares (R1-R2; Minor-Moderate radio blackouts).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Low during the last 24 hours. The largest flare was a C8.8-flare from AR4043 in the northeast at 27/2224 UTC. There are five sunspot regions on the Earth-facing solar disc, four numbered and one unnumbered. AR4043 remains the most significant region, a relatively small and stable bipolar region in the northeast, with a classification of Dai/beta-gamma. Most other regions are small, weak and magnetically simple and stable.

A filament eruption occurred around 27/2200 UTC from near S35E38. The associated CME is expected to pass below and behind Earths orbit.

Solar Wind / Geomagnetic Activity: Solar wind parameters as measured by DSCOVR at L1, continued to show the influence of a high speed stream (HSS) due to a connection with CH25/+. Solar winds initially started very strong, just above 800 km/s, on a slow declining trend to current strong levels of 650 km/s. Density has been below average. The Interplanetary Magnetic Field, Bt, started at Moderate levels at 8nT and since then has steadily declined to current weak levels around 5 nT. The north-south component, Bz, initially fluctuated between weak positive (northward) and weak negative (southward) orientation, ranging from +7nT and -5nT. Through the period Bz has favoured a positive (northward) orientation. The phi angle was predominantly positive (away from the Sun). Geomagnetic activity was Unsettled to Active (Kp3-Kp4).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at background levels. High energy electron flux (greater than 2 MeV) at GEO was at Background increasing to Moderate levels, with a peak level of 592 pfu at 28/1140 UTC . The 24-hour fluence was below the Active threshold. The observed integrated pfu was 7.77e6 at 28/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to moderate solar activity is expected, with a chance of further isolated M-class flares, probably from AR4043.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs currently feature in the forecast, although an eruption on 25th may give a slight chance of a glance on either days 2 or 3 (29 or 30th

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Mar), although this is low confidence.

Solar winds are currently strong, around 650km/s, due to the HSS from CH25/+. Solar winds are expected to remain strong through much of day 1 (28th) and then gradually decline to slightly elevated levels by day 4 (31st).

Mainly unsettled to active levels (Kp 3-4) are expected today (28th), with a chance of isolated G1/Minor Geomagnetic storm (Kp 5) intervals. Geomagnetic activity is then expected to steadily decline, becoming Quiet to Unsettled (Kp 1-3) through tomorrow (29th) but with a chance of isolated Active levels at first. Mainly Quiet activity (Kp 1-2) is expected by day 4 (31st).

Energetic Particles / Solar Radiation: High energy proton flux is expected to be at background levels, with a negligible chance of enhancement from any larger flares. High energy electron flux is expected to continue to increase, from initial Moderate levels to become diurnally High on day 1 or day 2 (28 or 29th) and then predominantly High by the end of the period. The associated fluence is therefore expected to rise above the Active threshold (1e8 integrated pfu) by the end of the forecast period, possibly as soon as day 2 (29th).

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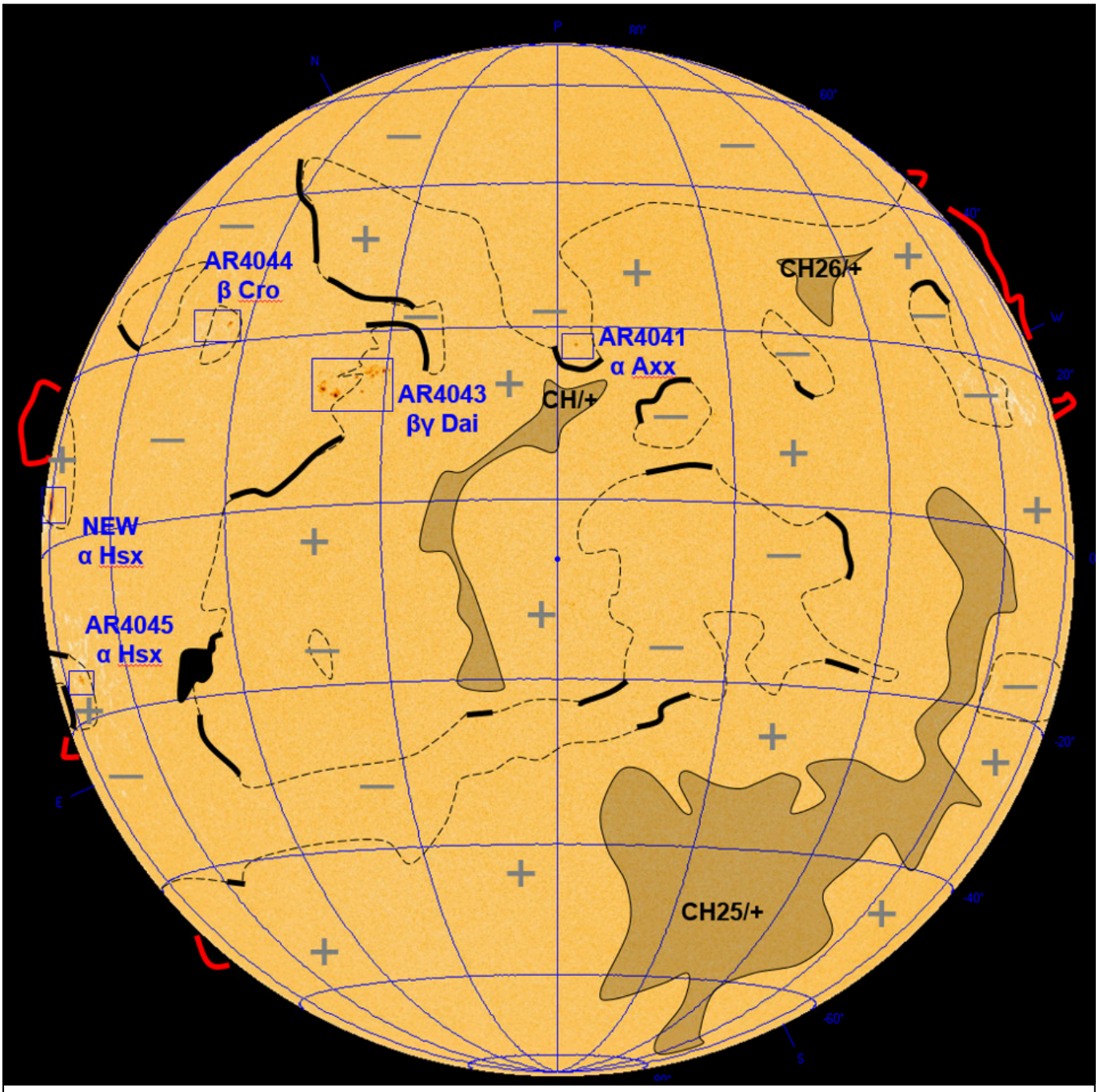
Figure 1: Synoptic Map valid 28/0800 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are no Earth-directed CMEs in the forecast at present. An eruption on 25th may give a slight chance of a glance on either days 2 or 3 (29 or 30th Mar) as indicated by MOSWOC Enlil ensemble forecast, although this is low confidence. Currently only one of the two filament eruptions that occurred on the 27th appears to have generated a CME, this from the later eruption around 27/2200 UTC from near S25E38. The associated CME is expected to pass below and behind Earths orbit.

During the previous 24 hours solar winds exceeded 800 km/s at times, and currently winds are around 650 km/s, therefore faster than indicated by MOSWOC Enlil. However, MOSWOC Enlil output is considered to be providing good guidance by indicating a very gradual declining trend in the wind speed, following a similar trend to the previous rotation of this persistent CH feature. Solar winds are expected to remain strong through much of day 1 (28th Mar) and then gradually decline to slightly elevated levels by day 4 (31st Mar).

Mainly unsettled to active levels (Kp 3-4) are expected on day 1 (28th), with a chance of isolated G1/Minor Geomagnetic storm (Kp 5) intervals. Geomagnetic activity is then expected to steadily decline, becoming Quiet to Unsettled (Kp 1-3) through day 2 (29th) but with a chance of isolated Active levels at first. Mainly Quiet activity (Kp 1-2) is expected by day 4 (31st).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	20	10	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
25/1741 UTC	Partial	Filament eruption	SE	1300 km/s	29/1800 UTC	Low confidnce as modelled on limited availability of imagery.

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Figure 2: MOSWOC Enlil

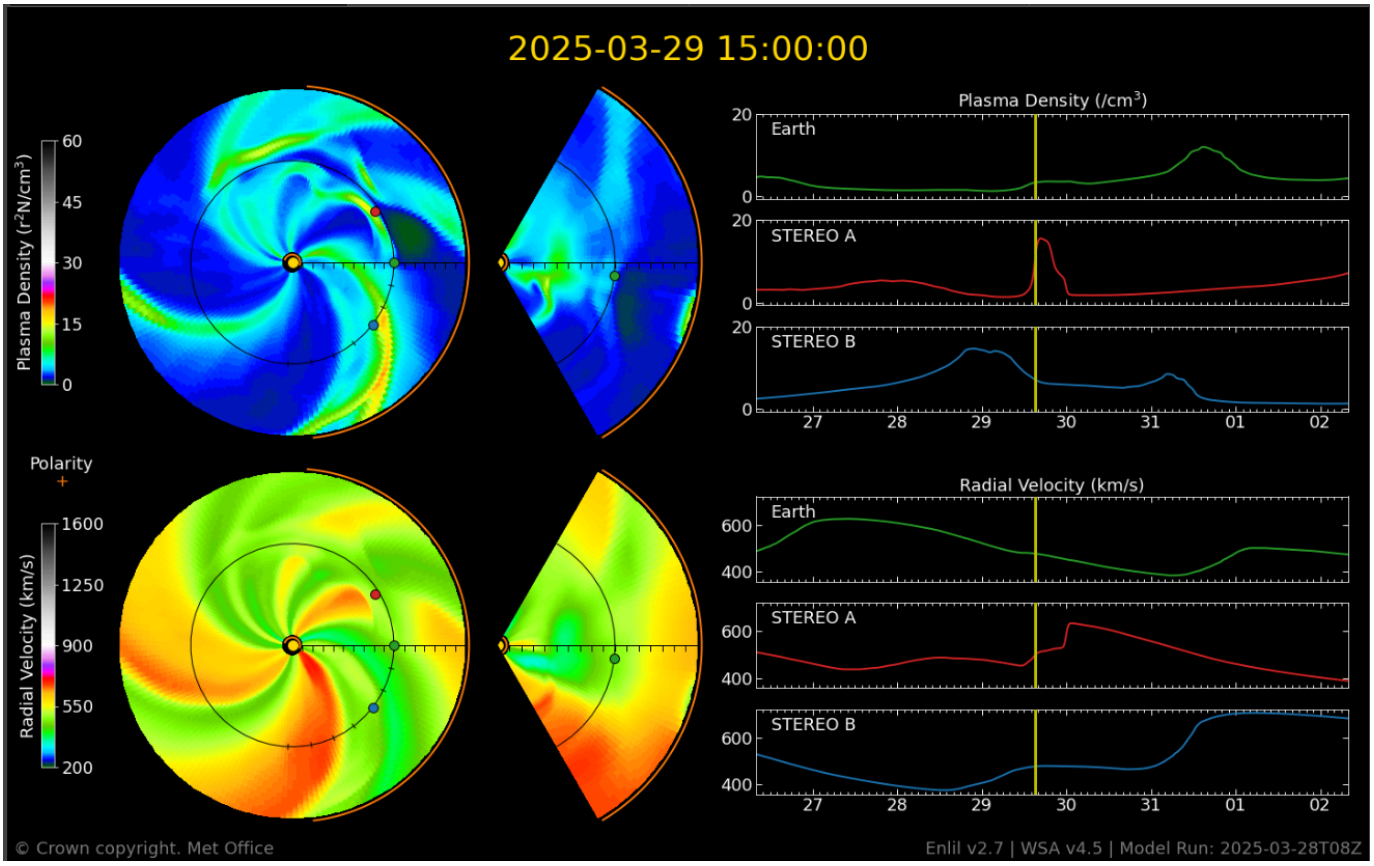
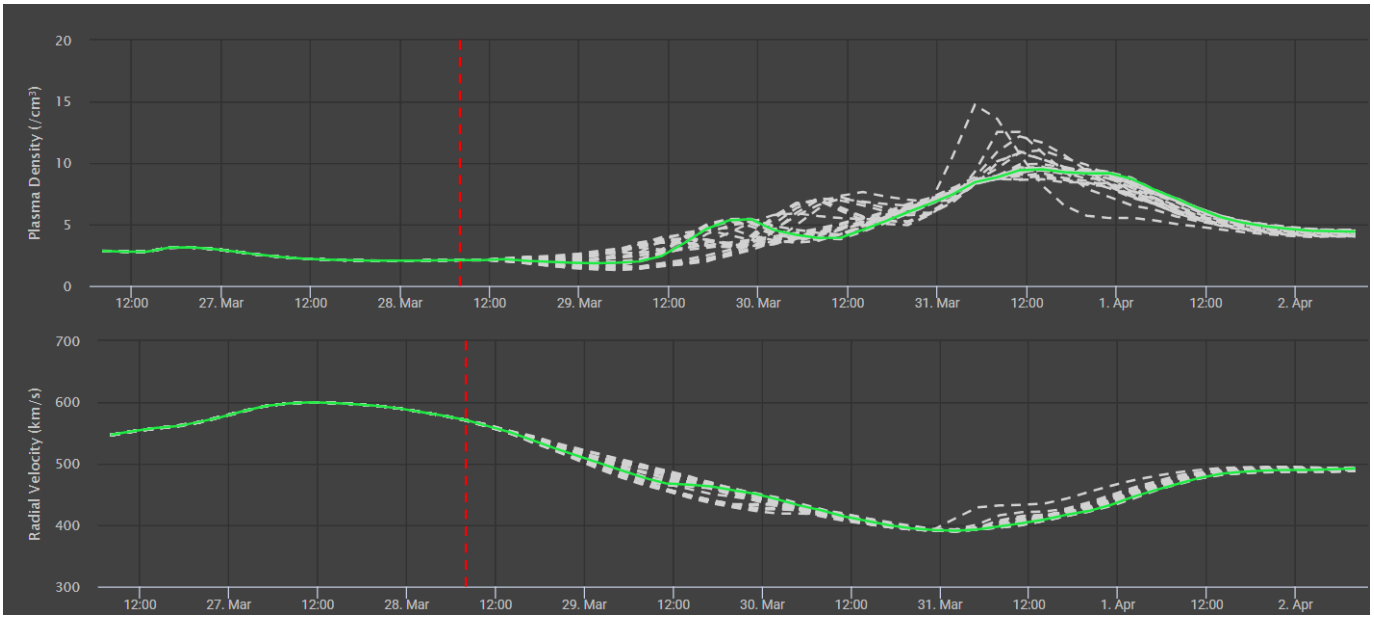


Figure 3: MOSWOC Enlil ensemble.



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Radio Blackouts - X-Ray Flares

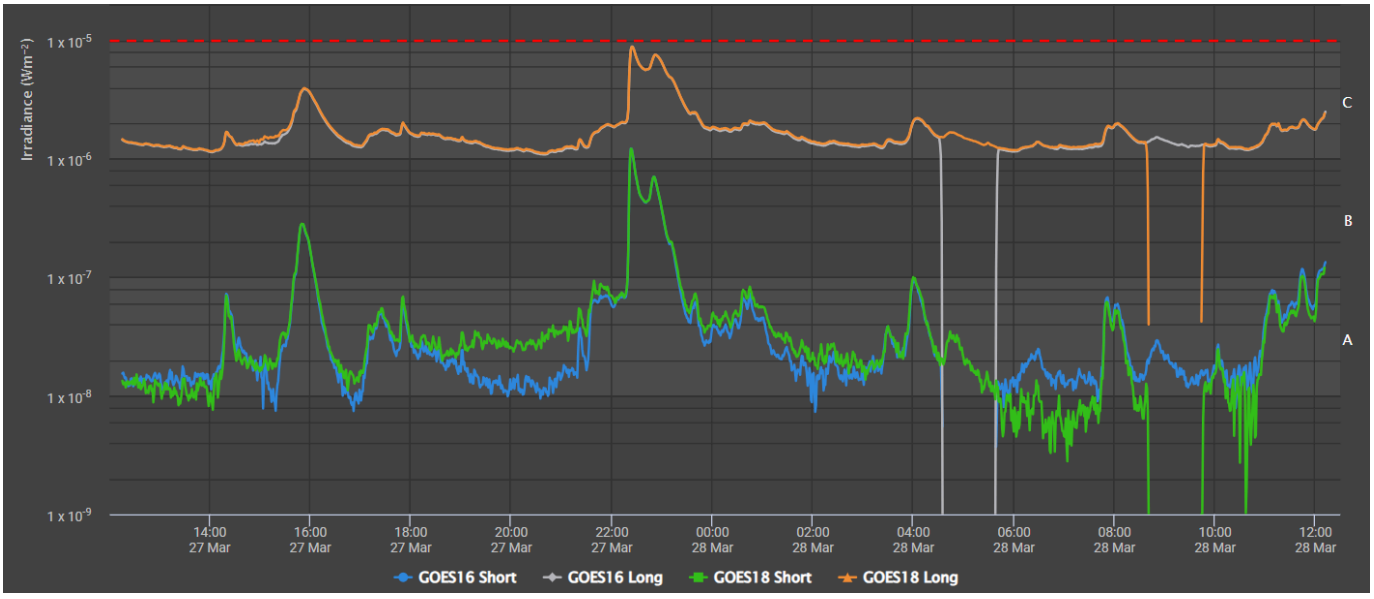
Solar activity was Low during the last 24 hours. The largest flare was a C8.8-flare from AR4043 in the northeast at 27/2224 UTC.

There are five sunspot regions on the Earth-facing solar disc, four numbered and one unnumbered. AR4043 remains the most significant region, a relatively small and stable bipolar region in the northeast, with a classification of Dai/beta-gamma. Most other regions are small, weak and magnetically simple and stable. AR4035 has now faded into a region of plage. A new and potentially large region is just appearing on the northeast limb and currently appears to be a mature, stable alpha region.

Low to moderate solar activity is expected, with a chance of further isolated M-class flares, probably from AR4043. However, new or returning regions are expected through the forecast period and may increase the solar activity.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 (M Class)	No	25	25	30	30
Very Active	R3-R5 (X Class)	No	1	1	1	1

Figure 4: GOES 18/16 X-ray Flux



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Solar Radiation Storms (High Energy Protons)

GOES18 high energy (>10MeV) proton flux was at background levels. Proton flux is expected to remain at background levels, with a negligible chance of enhancement due to the current lack of large, complex spot groups on the Earth facing disc.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2 MeV) measured by GOES16 at GEO was at background levels increasing to moderate levels through the past 24 hours. As the chance of enhanced geomagnetic activity (due to the HSS from CH25+) declines through the forecast period so the Van Allen belts should expand towards GEO, leading to a significant rise in the flux of high energy electrons from initial Moderate levels to become diurnally High during day 1 or day 2 (28th or 29th Mar) and then probably predominantly High by the end of the period.

The associated fluence is therefore expected to rise above the Active threshold (1e8 integrated pfu) by the end of the forecast period, possibly as soon as day 2 (29th). The MOSCOW REFM model is considered to be giving overall good guidance, showing fluence levels increasing above Active. However, confidence is lower in the speed of the Active threshold being breached, and confidence is significantly lower regarding the Very Active levels indicated by the model for days 3 and 4 (30th and 31st). Currently Very Active levels are not expected.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	50	70	90	95
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	5	10

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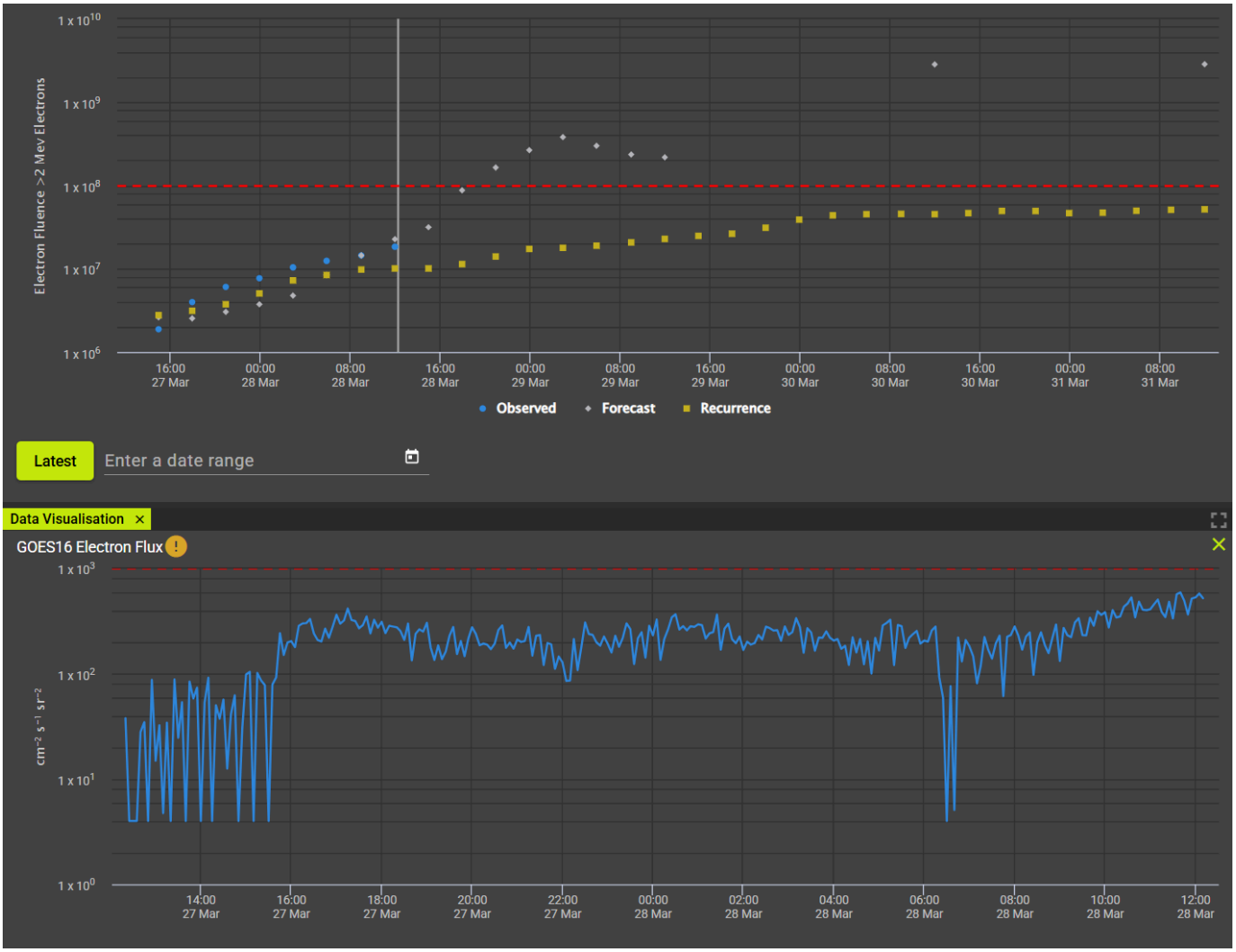
Figure 5: REFM Electron Fluence and GOES16 Electron Flux



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